UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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CRUISE REPORT
Japanese Charter Vessel Daian Maru #128
Cruise No. 90-01

Results of the Cooperative Japan/U.S. Echo Integration/Midwater Trawl Survey of Walleye Pollock in the Bering Sea in 1990

CRUISE PERIOD, AREA, AND SCHEDULE

A cooperative Japan/U.S. survey of walleye pollock (Theragra chalcogramma) in the Bering Sea was conducted between July 10 and October 1, 1990. U.S. scientific personnel participated aboard the chartered Japanese fishing vessel Daian Maru #128 as it conducted an echo integration/midwater trawl (EIMWT) survey. The vessel's itinerary was as follows:

July 10-16	Depart Kushiro, Japan. Transit to Dutch Harbor, Alaska.
July 17-19	Standard target calibration at Makushin Bay.
July 19-21	Embark U.S. scientist in Dutch Harbor. Transit to survey start.
July 21-August 10	Leg I. EIMWT survey of the eastern Bering Sea shelf.
August 11-17	Transit to Seward, Alaska, for inport. Exchange U.S. scientist.
August 18-20	Transit to Makushin Bay.
August 21-24	Standard target calibration at Makushin Bay.
August 25-September 4	Leg II. EIMWT survey of the central portion of the Aleutian Basin including international zone and U.S. territorial waters.

September 5	Transit to Dutch Harbor.
September 6-8	Dutch Harbor inport. Disembark Japanese scientist.
September 8-11	Standard target calibration at Makushin Bay.
September 12-16	Leg III-1. EIMWT survey of southeast portion of Aleutian Basin within U.S. territorial waters.
September 17	Touch and go, Dutch Harbor to exchange U.S. scientist and embark Japanese scientist.
September 17-19	Standard target calibration at Makushin Bay.
September 19-20	Transit to survey start.
September 21-26	Leg III-2. EIMWT survey of Aleutian Basin including international zone and U.S. territorial waters.
September 27-October 1	Transit to Kushiro, Japan. End of cruise.

OBJECTIVES

The principal objectives of the cruise were to:

1. Collect echo integration data and midwater and demersal trawl data to determine the distribution, biomass, and biological composition of walleye pollock in the Bering Sea.
2. Collect pollock target strength data for use in scaling echo integrator outputs to estimates of absolute abundance.
3. Collect dual beam measurements of a standard sphere to calibrate the acoustic system.

VESSEL, OCEANOGRAPHIC EQUIPMENT, AND TRAWL GEAR

The survey was completed on board the Daian Maru #128, a 59-m stern trawler chartered by the Fisheries Agency of Japan. Acoustic data were collected using a Japanese computerized echo integration and target strength measurement system. The echo sounder's receiver consisted of two 20 log R time varied gain (TVG) channels for echo integration and two 40 log R (TVG) channels for dual beam target strength measurements. The entire

system was installed in a portable container approximately 2 m x 2 m x 2.75 m. A 38 kHz dual beam transducer housed in a 1.3 m long V-fin was connected to the acoustic system by a 200 m, 26.4 mm diameter double-armored towing cable. The V-fin was towed at an average depth of 10 m at about 8 kts. The echo sounder transmitted at various repetition rates using a pulse length of about 0.6 milliseconds.

Echo sign was sampled using a dual purpose midwater-bottom net. The trawl mesh sizes ranged from 30 cm (12 inches) forward to 10 cm (4 inches) in the codend. The codend was equipped with a 4-mm (1.6-inch) mesh liner which was closed on all trawl hauls on sign thought to be juvenile pollock. The net was fished with 4.1 m x 2.7 m (8' x 12') steel rectangular doors and 41-kg (90-lb) tom weights.

Water temperature/depth profiles were obtained using expendable bathythermographs (XBT) at predetermined sites throughout the survey area.

SURVEY METHODS

Survey operations were conducted 24 hours a day. The survey design consisted of a series of parallel transects along a systematic trackline. Vessel speed while surveying was approximately 8 kts. Midwater and demersal trawl hauls were made at selected locations to identify echo sign and provide biological samples. In addition, samples of juvenile pollock were collected in the evenings with the codend liner closed when dense echo sign of smaller targets were observed, generally within 35 meters of the surface. Initially, the liner was placed at the end of the codend, which apparently limited fishing efficiency. After juvenile haul 13, the liner was moved to the front of the codend resulting in greater catch rates of age zero pollock.

Leg I of the survey covered the eastern Bering Sea shelf from the U.S./U.S.S.R. convention line to the Aleutian Island chain. The transect lines extended from about the 75 m depth contour to the edge of the continental shelf. The southernmost two transects were not completed because of lack of time. Legs II and III covered most of the Aleutian basin east of the U.S./U.S.S.R. convention line and south of 58°30', including the international waters over the Aleutian Basin.

Four standard sphere calibrations were conducted during the survey period. With the vessel anchored in Makushin Bay, a solid copper sphere of known acoustic properties was suspended below the transducer while target strength data were collected.

RESULTS

The survey transect patterns covered the eastern Bering Sea shelf and Aleutian Basin, including the international zone (Figure 1). A total of 72 trawl hauls were made during the cruise. There were 28 midwater (Figure 2) and 5 bottom hauls (Figure 3) without the liner in place targeting on adult pollock and 39 hauls with the liner closed targeting on age zero pollock (Figure 4). Trawl station and catch data are summarized for adult midwater (Table 1) and bottom hauls (Table 2). Trawl station data for juvenile hauls targeting age zero pollock are summarized in Table 3. Catch and length data from juvenile hauls are being analyzed by Japanese scientists. Biological samples and measurements collected during the survey are summarized in Table 4. Figure 5 shows the location of plankton sampling and XBT stations. Data collected during the survey were shared between Japanese and U.S. scientists with collection priority given to Japanese scientists. Results shown represent data compiled by U.S. scientists.

Pollock was the dominant species caught over the eastern Bering Sea shelf. In the adult midwater hauls, pollock accounted for 97% of the total weight and 98% of the total numbers of species caught (Table 5). North of the Pribilof Islands (north shelf, Figure 2) 10 adult midwater hauls contained pollock. The pollock length distribution for the north shelf was much broader than that of the south shelf, basin, or bottom fish. All lengths of fish were represented with sizes ranging from 13 cm to 66 cm (Figure 6). Juvenile pollock (less than 22 cm) were observed in 4 of the 10 hauls that encountered pollock. Most of the pollock caught south of the Pribilof Islands (south shelf, Figure 2) were over 40 cm (Figure 6), with the exception of haul 21 where juvenile pollock ranging from 17 cm to 24 cm were observed (Figure 6). An interesting observation is the lack of 25-40 cm fish on the south shelf.

Walleye pollock were observed in three bottom hauls sampling demersal echo sign over the eastern Bering Sea shelf (Figure 3). Pollock dominated catches taken on the bottom by weight (96%) and numbers (97%, Table 6). Only adult pollock were observed in the bottom hauls with length sizes ranging from 40 cm to 64 cm (Figure 6).

Seven adult midwater hauls were made over the Aleutian Basin with three of them occurring within the international zone (Figure 2). Pollock dominated representing 94% by weight and 99% by numbers (Table 7). Two hauls were sampled for length data by the U.S. scientist. Samples from the other five hauls were frozen and will be analyzed by Japanese scientists. Haul 25 contained adult pollock with a length range between 42 cm and 55 cm (Figure 6). Age zero pollock were captured in Haul 26 which occurred 150 nmi north of Amlia Island (Figure 2). Their lengths ranged between 4 cm and 7 cm (Figure 6).

SCIENTIFIC PERSONNEL

Name	Position	Organization	Date
Taku Yoshimura	Fishery Biologist	NRIFSF	7/10-8/15
Akira Nishimura	Fishery Biologist	NRIFSF	8/15-9/5 and 9/17-10/5
Yoshimi Takao	Fishery Engineer	NRIFE	8/15-10/5
Kohichi Sawada	Fishery Engineer	NRIFE	7/10-8/15
Joe Klein	Fishery Technician	AFSC	7/19-8/15 and 9/17-10/5
Dennis Benjamin	Fishery Technician	AFSC	8/15-9/17

NRIFSF - National Research Institute of Far Seas Fisheries, Shimizu, Japan
NRIFE - National Research Institute of Fisheries Engineering, Tokyo, Japan
AFSC - Alaska Fisheries Science Center, Seattle, Washington

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Table 1. Adult midwater trawl station and catch summary data from the summer 1990 Japan/US cooperative EIMWT survey of the Bering Sea.

Haul	Date (1990)	Equil Hour (ADT)	Start Position Lat(N)	Long(W)	Depth (fm) Gear/bottom	Duration (hr)	Distance (nm)	Catch (lbs/nos) Walleye Pollock	Other species
1	7/21	20	62 18.6	175 13.5	35/45	1.2	6.0	0	2/69
2	7/22	23	60 49.5	177 15.9	22/72	0.4	1.4	14/25	0
3	7/22	24	60 51.2	177 12.1	38/71	1.0	5.0	14,147/22,044	1/1
4	7/23	18	59 39.8	178 30.0	98/180	0.5	2.4	1,443/3,156	29/13
5	7/23	22	59 52.9	177 57.3	66/81	0.3	1.5	1791/2163	16/3
6	7/24	13	60 51.7	175 42.1	44/63	0.5	2.9	3095/2819	9/3
7	7/25	24	59 49.8	176 41.8	41/77	0.3	1.4	3093/5820	0
8	7/27	12	59 38.6	175 41.5	61/78	0.3	1.3	939/5457	1/1
9	7/27	18	59 48.0	175 19.4	41/71	0.7	2.8	2308/2910	0
10	7/29	17	58 54.0	174 32.6	47/75	0.5	2.5	0	48/16
11	7/29	23	59 12.9	173 47.3	49/107	0.5	2.1	2037/1622	0
12	7/31	01	58 24.1	174 14.0	66/79	0.5	2.4	147/73	60/30
13	7/31	13	57 58.7	173 46.2	60/71	0.3	1.7	0	1/1
14	7/31	14	57 57.3	173 48.1	57/74	0.4	2.1	0	26/17
15	8/5	01	56 29.2	171 30.0	77/108	0.4	1.7	260/136	15/58
16	8/5	17	56 07.5	170 51.4	137/150	0.5	1.9	145/67	351/336
17	8/6	06	56 00.8	169 43.6	179/189	0.4	1.9	264/128	3/80
18	8/6	20	56 39.8	168 11.5	33/60	0.5	2.2	4/4	275/106
19	8/7	20	55 24.1	168 05.3	84/93	0.5	2.4	198/102	14/90
20	8/9	03	55 46.6	165 55.3	53/68	1.2	6.1	3232/1588	60/21
21	8/9	14	55 14.5	167 11.4	52/82	0.7	3.4	591/4183	37/26
22	8/28	21	57 57.8	178 59.6 E	125/2049	1.0	5.0	392/182	4/1
23	8/29	24	55 40.2	178 59.9	124/2067	0.9	4.0	130/68	6/3
24	9/1	14	55 24.9	177 00.2	116/2051	1.5	7.3	630/266	0
25	9/12	19	53 00.1	173 28.9	*/1182	1.5	6.8	464/213	46/9
26	9/13	15	54 43.0	173 30.0	64/1960	0.7	2.8	31/8266	6/2
27	9/15	17	53 31.4	170 30.2	103/1167	2.5	11.4	312/141	54/18
28	9/24	17	57 59.1	177 00.1 E	109/2055	2.0	10.0	34/14	4/2

"*" represents no gear depth data.

Table 2. Bottom trawl station and catch summary data from the summer 1990 Japan/US cooperative EIMWT survey of the Bering Sea.

Haul	Date (1990)	Equil Hour (ADT)	Start Position Lat(N)	Long(W)	Depth (fm) Gear/bottom	Duration (hr)	Distance (nm)	Catch (lbs/nos) Walleye Pollock	Other species
1	7/26	22	58 47.0	177 39.8	156/156	0.6	3.4	0	106/6
2	8/2	03	57 23.5	173 44.2	79/79	0.5	2.3	77000/43209	0
3	8/6	21	56 37.6	168 16.3	61/61	0.4	1.8	13617/7975	1272/368
4	8/7	21	55 27.2	168 08.5	108/108	0.2	0.8	10595/4377	611/192
5	8/9	19	54 58.0	167 41.7	291/291	1.0	5.5	0	1982/886

Table 3. Juvenile midwater trawl station summary data from the summer 1990 Japan/US cooperative EIMWT survey of the Bering Sea.

Haul	Date (1990)	Equil Hour (ADT)	Start Position Lat(N)	Long(W)	Depth (fm) Gear/bottom	Duration (hr)	Distance (nm)
1	7/22	02	62 23.7	174 20.4	8/38	0.5	2.6
2	7/23	03	60 40.2	177 37.2	8/83	0.3	1.3
3	7/24	12	60 51.9	175 41.1	16/62	0.5	2.6
4	7/26	02	59 47.2	176 47.9	11/74	0.5	2.4
5	7/27	13	59 36.9	175 44.6	12/77	0.5	2.5
6	7/28	02	60 19.4	174 05.4	12/50	0.5	2.5
7	7/29	13	58 41.5	175 01.0	12/100	0.5	2.6
8	7/29	24	59 10.7	173 52.2	11/65	0.5	2.6
9	7/30	16	58 59.1	172 50.6	12/60	0.5	2.2
10	7/31	02	58 25.9	174 10.3	9/79	0.5	2.4
11	7/31	15	57 59.4	173 42.9	12/69	0.4	2.1
12	8/1	05	58 45.3	171 57.4	12/54	0.5	2.6
13	8/2	02	57 23.1	173 41.5	8/75	0.5	2.5
14	8/2	15	56 57.0	173 13.3	29/81	0.4	1.7
15	8/2	24	57 34.2	171 45.1	8/60	0.3	2.1
16	8/3	17	58 02.1	169 37.6	27/40	0.3	1.5
17	8/3	18	58 00.0	169 34.5	6/40	0.3	1.6
18	8/4	24	56 30.2	171 27.8	8/81	0.3	1.8
19	8/6	04	56 01.5	169 41.9	8/137	0.3	2.1
20	8/6	19	56 41.6	168 08.5	9/60	0.3	1.6
21	8/7	19	55 27.6	168 08.4	11/92	0.5	2.2
22	8/7	23	55 30.0	168 02.1	16/84	0.4	1.8
23	8/8	15	56 35.5	165 28.5	13/44	0.5	2.8
24	8/8	16	56 33.7	165 32.6	27/44	0.4	1.9
25	8/9	05	55 48.8	165 47.5	22/65	0.5	2.6
26	8/26	02	53 01.8	-179 00.1	12/1325	0.5	2.5
27	8/26	24	53 09.8	-179 00.1	10/1545	0.5	2.7
28	8/27	24	55 52.6	-178 59.9	13/2078	0.3	1.6
29	8/28	23	57 54.6	-179 00.2	9/2030	0.3	1.7
30	8/29	23	55 39.1	178 59.6	9/2100	0.3	1.8
31	8/30	24	53 00.5	178 59.8	16/1990	0.5	2.6
32	9/1	23	56 06.7	177 00.1	12/2012	0.5	2.6
33	9/12	24	53 11.2	173 30.3	12/1654	0.5	2.9
34	9/13	24	55 30.0	173 17.3	12/1904	0.5	2.2
35	9/14	24	53 32.3	171 59.8	16/1450	0.5	2.6
36	9/23	08	56 25.7	-176 59.9	11/2049	0.5	2.4
37	9/24	10	56 55.3	-174 59.8	11/2027	0.5	2.5
38	9/25	08	54 30.2	-174 59.8	8/2109	0.3	1.7
39	9/26	08	55 11.7	-172 59.9	7/2060	0.3	1.8

Table 4. Summary of biological samples and measurements from the summer 1990 Bering Sea Japan/US cooperative EIMWT survey of the Bering Sea.

	Haul No.	Length	Otoliths	Maturity	Fish Weights	Ovary Weights	Stomach Collection
Adult	1	0	0	0	0	0	0
Midwater	2	0	0	25	25	0	0
	3	501	50	50	50	0	0
	4	712	30	30	30	11	30
	5	534	0	0	0	0	0
	6	597	40	40	40	25	40
	7	861	40	40	40	20	40
	8	584	40	40	40	24	40
	9	405	40	40	40	11	40
	10	0	0	0	0	0	0
	11	373	40	40	40	18	40
	12	73	0	0	0	0	0
	13	0	0	0	0	0	0
	14	0	0	0	0	0	0
	15	136	0	0	0	0	0
	16	67	0	0	0	0	0
	17	128	0	0	0	0	0
	18	4	0	0	0	0	0
	19	102	0	0	0	0	0
	20	440	40	40	40	23	40
	21	32	0	0	0	0	0
	22	0	40	40	40	20	40
	23	0	0	0	0	0	0
	24	0	40	40	40	0	40
	25	76	40	40	40	20	40
	26	1	0	0	0	0	0
	27	0	40	40	40	20	40
	28	0	0	0	0	0	0
Bottom	1	0	0	0	0	0	0
	2	479	40	40	40	18	40
	3	469	40	40	40	18	40
	4	329	40	40	40	23	40
	5	0	0	0	0	0	0
Total		6903	600	625	625	251	550

Table 5. Summary of catch by species in 28 adult midwater trawls from the summer 1990 Japan/US cooperative EIMWT survey of the Bering Sea shelf.

Species	Numbers	Percent	(lb)	Percent
Walleye Pollock (Theragra chalcogramma)	52,297	98.4	33,710	97.3
Shrimp Unidentified (Decapoda)	337	.6	5	<.1
Jellyfish Unidentified (Scyphozoa)	138	.3	347	1.0
Northern Smoothtongue (Leuroglossus schmidti)	78	.1	1	<.1
Arctic Cod (Boreogadus saida)	68	.1	2	<.1
Arrowtooth Flounder (Atheresthes stomias)	47	.1	106	.3
Squid Unidentified (Teuthoida)	46	.1	11	<.1
Sculpin Unidentified (Cottidae)	34	.1	11	<.1
Flathead Sole (Hippoglossoides elassodon)	30	.1	28	<.1
Pacific Ocean Perch (Sebastes alutus)	16	<.1	21	<.1
Pacific Cod (Gadus macrocephalus)	14	<.1	142	.4
Rex Sole (Glyptocephalus zachirus)	14	<.1	16	<.1
Pacific Herring (Clupea pallasii)	13	<.1	6	<.1
Rockfish Unidentified (Sebastes sp.)	11	<.1	139	.4
Greenland Turbot (Reinhardtius hippoglossoides)	6	<.1	50	.1
Rock Sole (Lepidopsetta bilineata)	5	<.1	6	<.1
Chum Salmon (Oncorhynchus keta)	3	<.1	19	.1
Shortspine Thornyhead (Sebastolobus alascanus)	3	<.1	8	<.1
Pacific Lamprey (Lampetra tridentata)	2	<.1	3	<.1
Smooth Lumpsucker (Aptocyclus ventricosus)	2	<.1	8	<.1
Totals	53,164	100.0	34,639	100.0

Table 6. Summary of catch by species in 5 bottom trawls from the summer 1990 Japan/US cooperative EIMWT survey of the Bering Sea shelf.

Species	Numbers	Percent	(lb)	Percent
Walleye Pollock (Theragra chalcogramma)	55,561	97.4	101,212	96.2
Squid Unidentified (Teuthoida)	345	.6	302	.3
Arrowtooth Flounder (Atheresthes stomias)	277	.5	471	.4
Shortspine Thornyhead (Sebastolobus alascanus)	242	.4	378	.4
Grenadier Unidentified (Macrouridae)	163	.3	625	.6
Pacific Cod (Gadus macrocephalus)	124	.2	1161	1.1
Flathead Sole (Hippoglossoides elassodon)	123	.2	116	.1
Sablefish (Anoplopoma fimbria)	37	.1	204	.2
Tanner Crab Unidentified (Chionoecetes sp.)	37	.1	13	<.1
Greenland Turbot (Reinhardtius hippoglossoides)	34	.1	315	.3
Eelpout Unidentified (Zoarcidae)	29	.1	51	<.1
Sculpin Unidentified (Cottidae)	12	<.1	35	<.1
Pacific Halibut (Hippoglossus stenolepis)	8	<.1	124	.1
Rex Sole (Glyptocephalus zachirus)	8	<.1	10	<.1
Pacific Ocean Perch (Sebastes alutus)	5	<.1	6	<.1
Skate Unidentified (Rajidae)	3	<.1	85	.1
Rougheye Rockfish (Sebastes aleutianus)	2	<.1	10	<.1
Rockfish Unidentified (Sebastes sp.)	2	<.1	4	<.1
Rock Sole (Lepidopsetta bilineata)	1	<.1	2	<.1
Snailfish Unidentified (Cyclopteridae)	-	-	58	.1
Totals	57,013	100.0	105,182	100.0

Table 7. Summary of catch by species in 7 adult midwater trawls from the summer 1990 Japan/US cooperative EIMWT survey of the Aleutian basin, including the international zone.

Species	Numbers	Percent	(lb)	Percent
Walleye Pollock (Theragra chalcogramma)	9,146	99.6	1994	94.3
Smooth Lumpsucker (Aptocyclus ventricosus)	29	0.3	113	5.3
Jellyfish Unidentified (Scyphozoa)	5	<.1	6	0.3
Pacific Lamprey (Lampetra tridentata)	1	<.1	1	<.1
Totals	9,181	100.0	2114	100.0

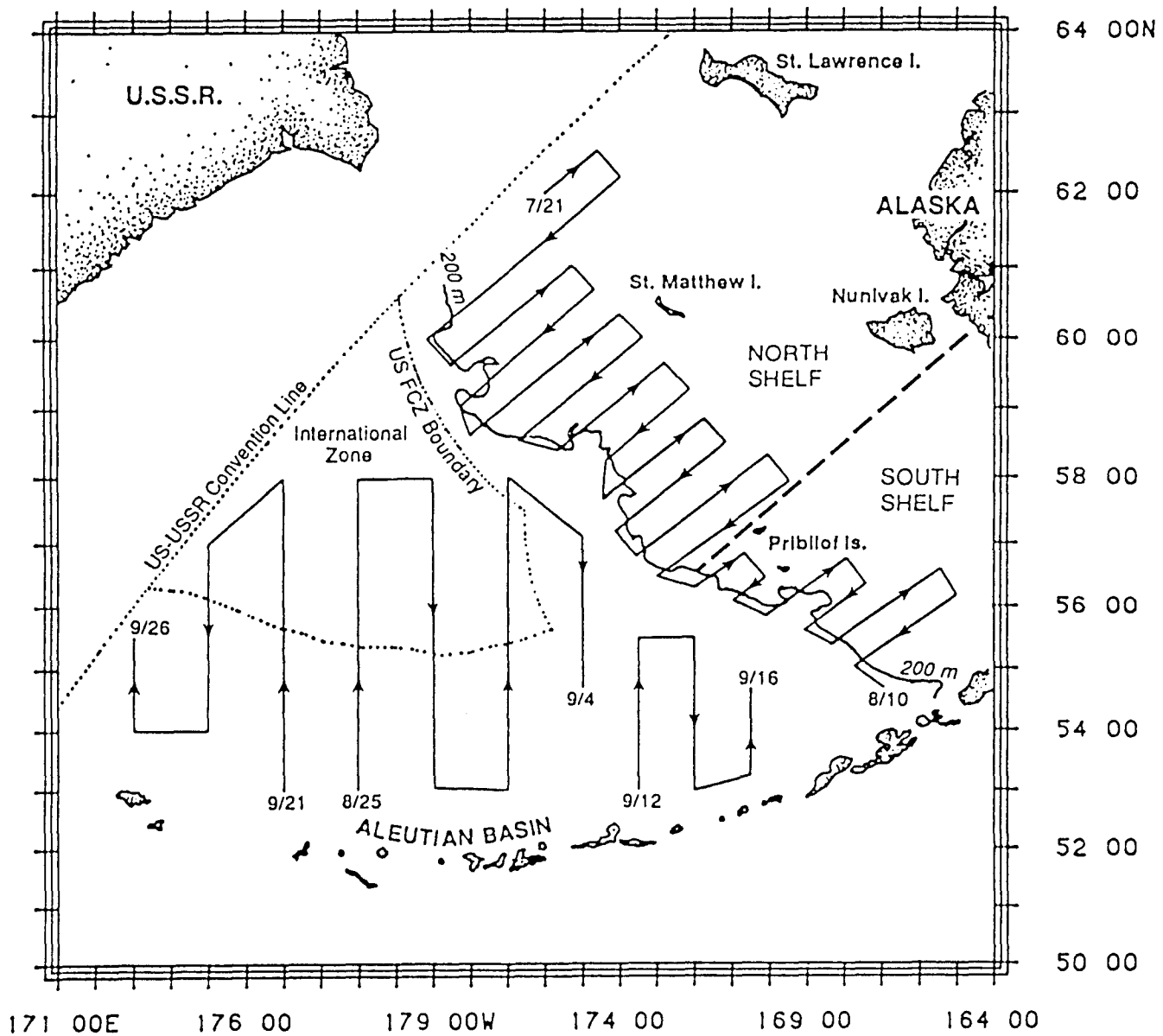

Figure 1. Survey trackline for summer 1990 Japan/U.S.cooperative EIMWT survey of the Bering Sea.

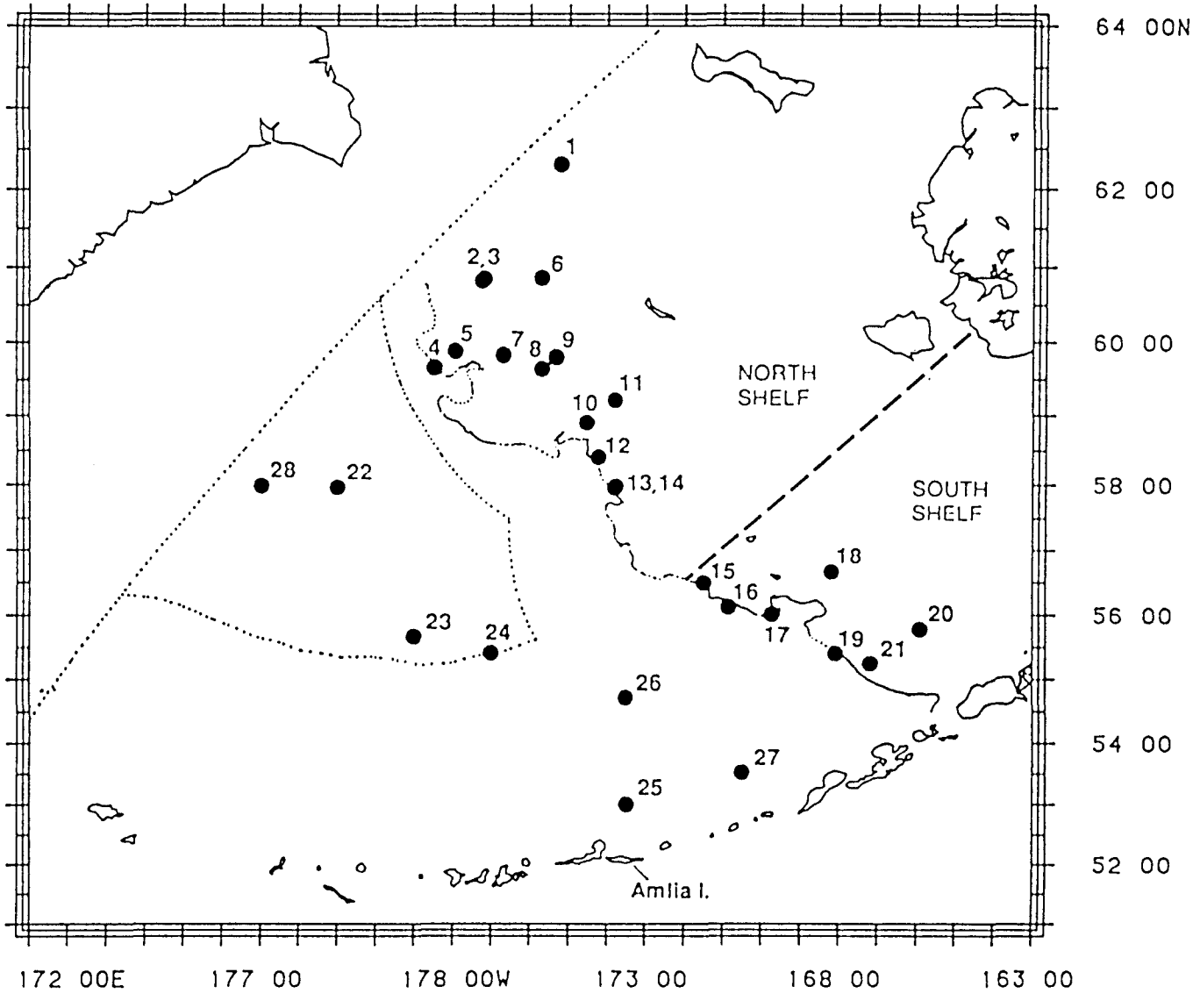

Figure 2. Adult midwater trawl stations for the summer 1990 Japan/ U.S. cooperative EIMWT survey of the Bering Sea.

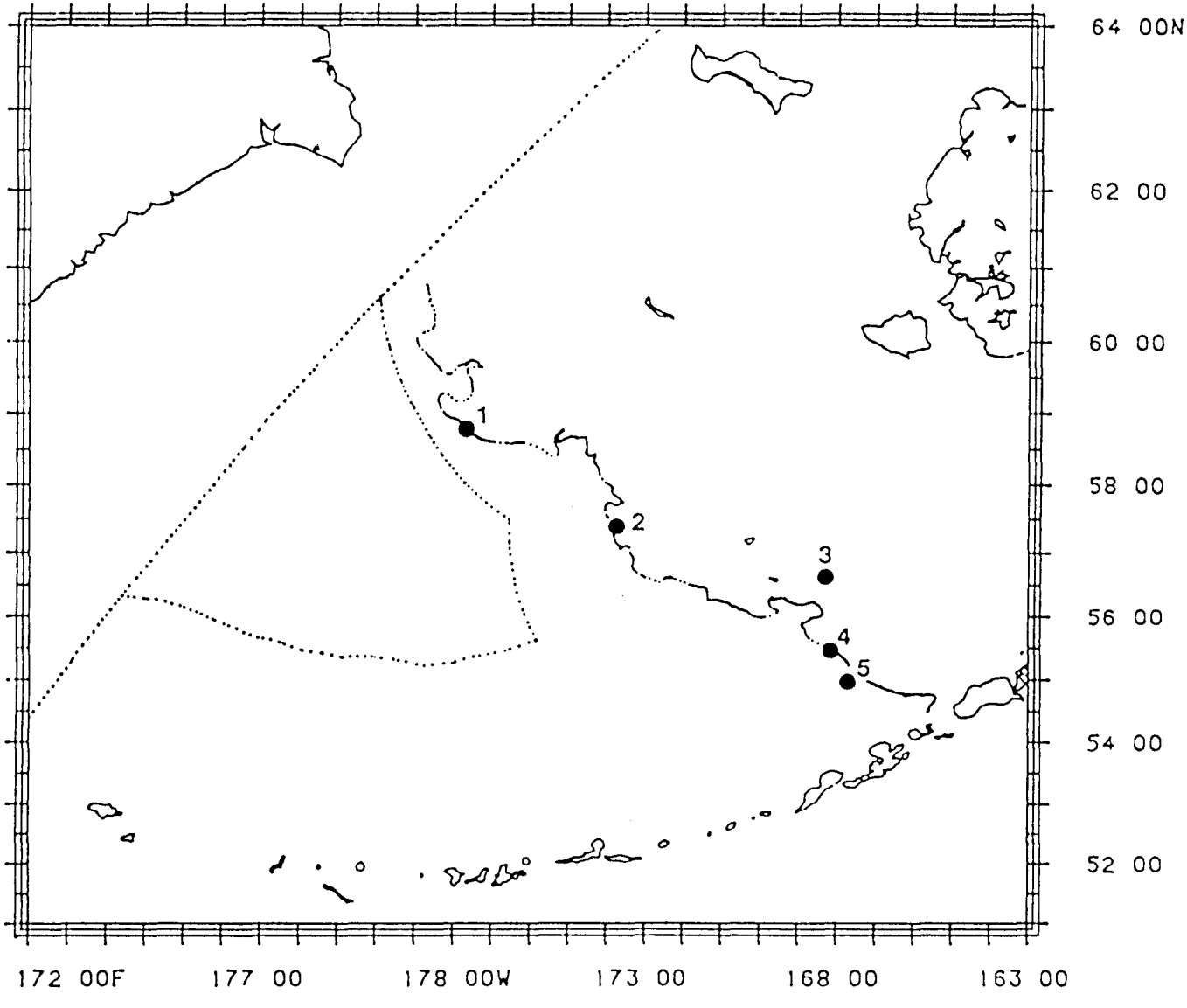

Figure 3. Bottom trawl stations for the summer 1990 Japan/U.S. cooperative EIMWT survey of the Bering Sea.

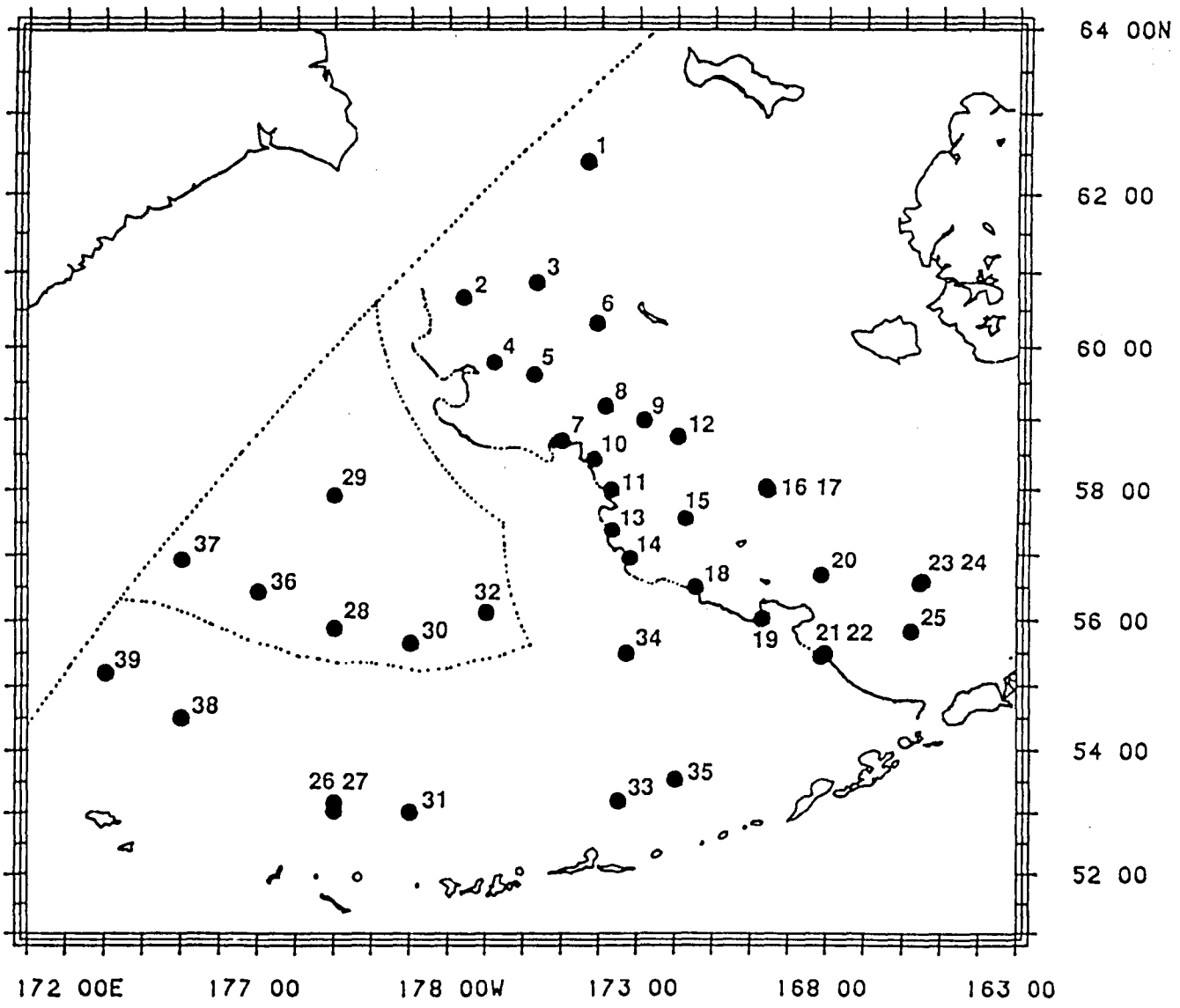

Figure 4. Juvenile midwater trawl stations for the summer 1990 Japan/U.S. cooperative EIMWT survey of the Bering Sea.

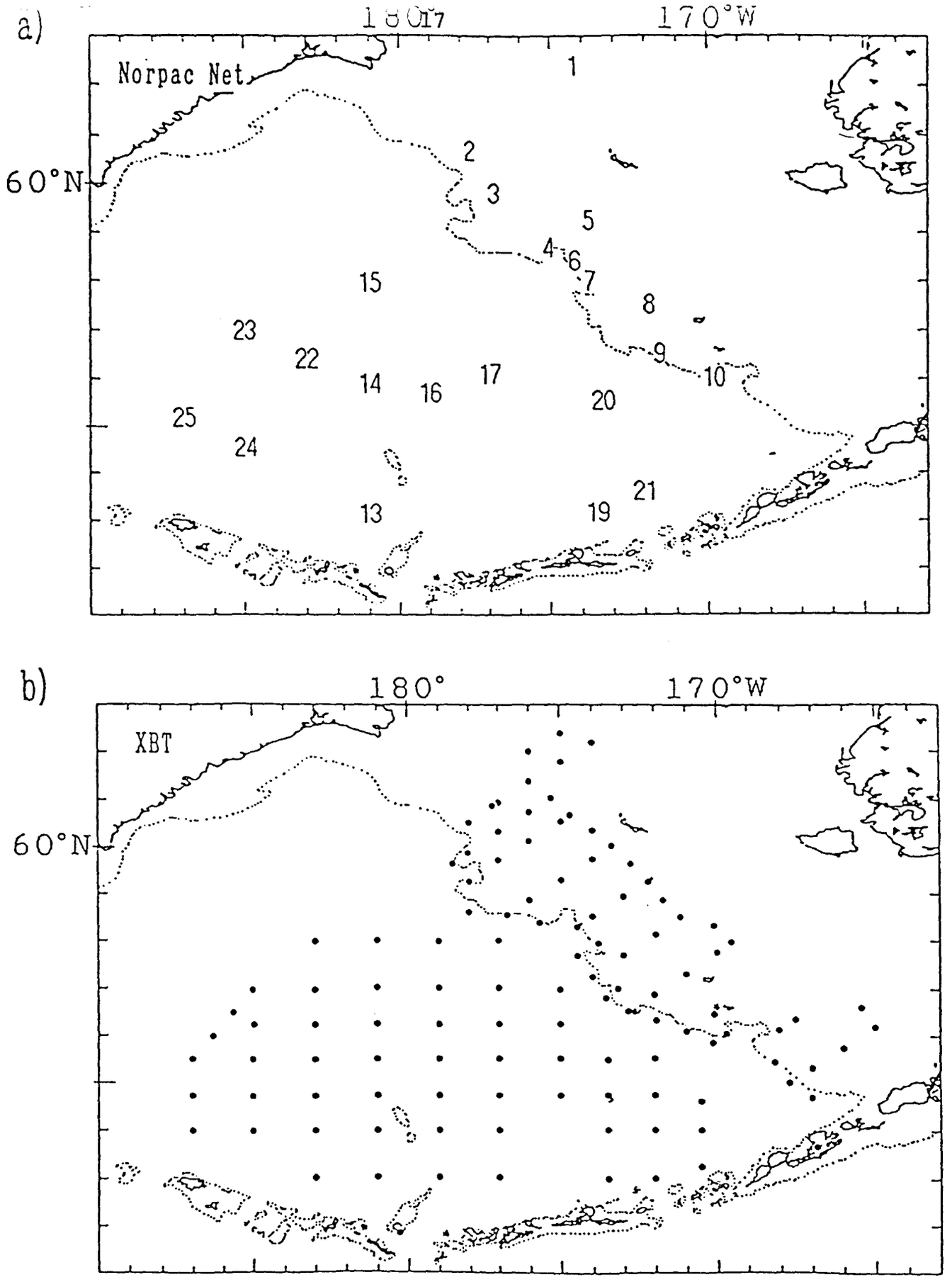

Figure 5. Summer 1990 Bering Sea pollock survey. Location of plankton sampling and XBT cast stations.

a: Norpac net stations.
b: XBT cast stations.

Obtained from May 1991 INPFC Working Group, document Japan 9.

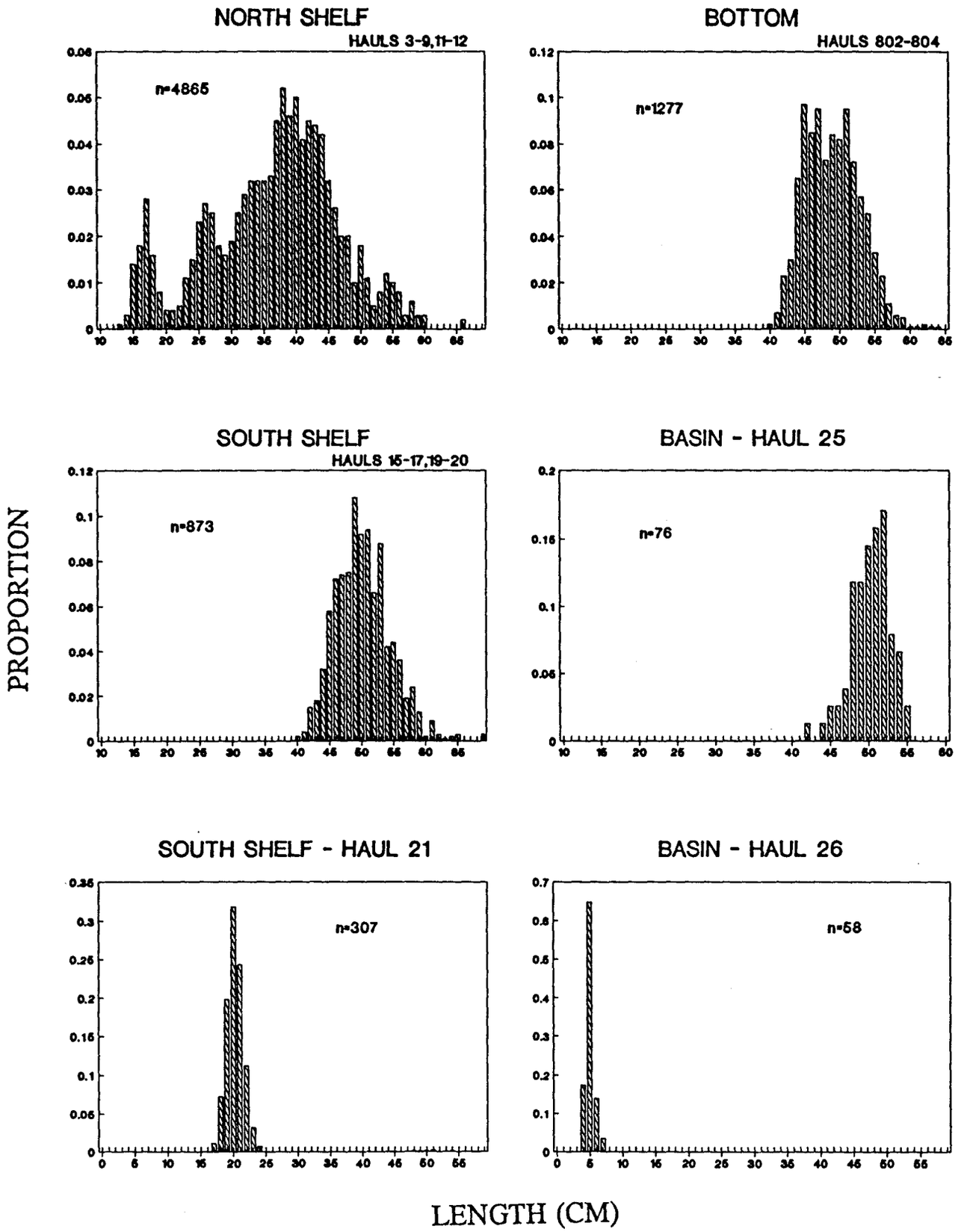

Figure 6. Length composition of pollock (unweighted by population size) for the summer 1990 Japan/U.S. cooperative EIMWT survey of the Bering Sea. Areas indicated in this figure refer to geographical areas presented in figure 1.